

REMARKS

Claims 1-10 are pending in the case. All claims stand rejected. In the present submission, claims 1 and 6 have been amended. Applicants have also amended the specification to correct typographical errors. Reconsideration is respectfully requested.

Specification Objections

The Examiner objected to the specification for the recitation of " $\Delta\tau$ " on page 3 of the specification. In the present submission, the specification has been amended as required by the Examiner. Withdrawal of the claim objection is respectfully requested.

Claim Objections

The Examiner objected to claims 1 and 6 for the following informalities: the term " $\Delta\tau$ " was not defined in the equation and should be replaced with " Δt " instead. In the present submission, Applicant has amended claims 1 and 6 to recite " $\delta(\Delta t)$ " and also to include the definition of the delta function. Applicant submits that the present amendment overcomes the Examiner's objection. Withdrawal of the claim objections is respectfully requested.

§101 Rejection

The Examiner has rejected claims 1-10 under 35 U.S.C. §101 because the claimed invention is directed to non-statutory subject matter. (See Office Action, p.2.) In particular, the Examiner contends that the claimed invention is based merely on mathematical manipulation of abstract idea with any limitation to a particular problem. With regard to claim 1, the Examiner contends that:

Regarding claim 1, a method claim – it first does some mathematical calculation of signal sequences to see if it satisfies an equation to generate a padded signal frame for transmission. Then the transmitted padded signal is received and runs through some more mathematical manipulations to form a remainder signal according to another equation. Since claim 1 does not call for any computer operation, it will be just a method to merely manipulate purely mathematical problems. The intervening steps of "transmitting" and "receiving" only serves as simple transports of those signals that provides no significant limitations for practical application. (Office Action, p. 3.)

With regard to claim 6, the Examiner contends that the "apparatus claim calls for a system comprising a computer that is programmed to do...mathematical manipulations of data without any limitation to a practical application." The dependent claims 2-5 and 7-10 are rejected for the same reasons as their associated independent claims. Applicant respectfully traverses the rejection.

Applicant respectfully submits that the above characterization of the claimed invention of claims 1 and 6 is in error and the Examiner has omitted important claim limitations present in claims 1 and 6 to arrive at the §101 rejection. Applicant submits that when claims 1 and 6 are each considered as a whole, the claims do indeed recite claimed inventions having at least one useful and practical application.

Applicable Law and Examination Guidelines

To constitute statutory subject matter, "[t]he **claimed invention as a whole** must accomplish a practical application. That is, it must produce a 'useful, concrete and tangible result.'" See MPEP §2106, section II-A, citing *State Street Bank & Trust Co. v. Signature Financial Group Inc.*, 149 F.3d 1368, 1373 (Fed. Cir. 1998); emphasis added. "Accordingly, a complete disclosure should contain some indication of the practical application for the claimed invention, i.e., why the applicant believes the claimed invention is useful." *Id.* Furthermore, "[t]he **claimed invention as a whole** must produce a "useful, concrete and tangible" result to have a practical application." *Id.*; emphasis added.

In MPEP §2106, section II-A, several examples of claimed inventions that have a practical application because they produce useful, concrete, and tangible result are given. The following two examples are of particular interest:

- Claims drawn to a **long-distance telephone billing process** containing mathematical algorithms were held to be directed to patentable subject matter because "the claimed process applies the Boolean principle to produce a useful, concrete, tangible result without pre-empting other uses of the mathematical principle." *AT&T Corp. v. Excel Communications, Inc.*, 172 F.3d 1352, 1358, 50 USPQ2d 1447, 1452 (Fed. Cir. 1999);

- "[T]ransformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation, because it produces 'a

useful, concrete and tangible result' -- **a final share price momentarily fixed for recording and reporting purposes** and even accepted and relied upon by regulatory authorities and in subsequent trades." *State Street*, 149 F.3d at 1373, 47 USPQ2d at 1601...(MPEP §2106, section II-A; emphasis added.)

In the *AT&T* case, the claimed invention of the patent is "a message record for long-distance telephone calls that is enhanced by adding a primary interexchange carrier ("PIC") indicator. The addition of the indicator aids long-distance carriers in providing differential billing treatment for subscribers, depending upon whether a subscriber calls someone with the same or a different long-distance carrier... The PIC indicator therefore enables IXCs to provide differential billing for calls on the basis of the identified PIC." *AT&T*, at 1353-1354.

It is important to note from the above two examples that while a method must provide a useful, concrete and tangible result to constitute statutory subject matter, there is no requirement that the claimed invention includes the actual use or the actual application of that result (the "PIC indicator" or the "final share price"). For example, the *AT&T* patent provides a PIC indicator that is *to be used* by long-distance carriers and the *State Street* patent provides a final share price that is *to be used* for recording and reporting purposes. However, the claimed inventions of those two patents do not include the actual application and use of their respective useful, concrete and tangible results.

MPEP §2106 also provides the examination guidelines in determining patentable subject matter for computer-related inventions. Among other things, MPEP §2106, section II, suggests that "[o]ffice personnel should review the **entire disclosure** to determine the features necessary to accomplish at least one asserted practical application" (emphasis added). Furthermore, "when evaluating the scope of a claim, **every limitation in the claim must be considered**. Office personnel may not dissect a claimed invention into discrete elements and then evaluate the elements in isolation. Instead, **the claim as a whole must be considered**. See, e.g., *Diamond v. Diehr*, 450 U.S. at 188-89..." (emphasis added).

Claim 1

Claim 1, as a whole, recites:

1. A method of **estimating timing** of at least one of the beginning and the end of a transmitted signal segment **in the presence of time delay in a signal transmission channel** in an OFDM system, the method comprising:

providing a set of pseudo-random signal m-sequences $PN(t;k)$ ($k = 1, \dots, K$; $K \geq 1$) for which a convolution signal formed from any two sequences satisfies $PN(t;i) * PN(t + \Delta t;j) = \delta(\Delta t) * \delta(i,j)$, where i and j are index numbers identifying the two sequences, t is a time variable, $\delta(\Delta t)$ is a modified delta function with infinitesimal width $\Delta t1$ ($\delta(\Delta t) = 0$ for $|\Delta t| > \Delta t1$) and $\delta(i,j) = 0$ unless $i = j$;

appending a selected sequence $PN(t;k)$ from the set of pseudo-random signal m-sequences $PN(t;k)$ **to at least one signal frame to be transmitted to form a padded signal frame**;

transmitting at least one padded signal frame as the transmitted signal through the signal transmission channel in which the transmitted signal may be received with an uncontrollable time delay $\Delta t(\text{delay})$;

receiving a received signal $Rc(t)$ of the transmitted signal associated with the at least one padded signal frame being transmitted and forming a composite signal, denoted as $Rc(t; \Delta t; \text{comp})$, given as:

$$Rc(t; \Delta t; \text{comp}) = \sum_{k=k1}^{k2} PN(t + \Delta t; k) * Rc(t),$$

where Δt is a selected time increment and $k1$ and $k2$ satisfy $1 \leq k1 \leq k2 \leq K$;

forming a remainder signal, denoted as $Rc(t; \text{rem})$, where $Rc(t; \text{rem}) = Rc(t) - Rc(t; \Delta t; \text{comp})$; and

determining from the remainder signal at least one time at which said selected sequence $PN(t;k)$ ($k = k1, k1+1, \dots, k2$) associated with said at least one padded signal frame begins in the received signal $Rc(t)$. (Emphasis added.)

The claimed invention of claim 1 involves the process of forming a padded signal frame by appending a selected pseudo-random signal m-sequence, transmitting the padded signal frame, and receiving a received signal, and finally, processing the received signal to *determine a time when the selected sequence begins in the receive signal*. This "time" value provided by the claimed invention of claim 1 is a useful, concrete and tangible result of the claimed invention.

As explained in Applicant's specification, page 1, lines 9-23:

Transmission of Internet signals and of digital television (TV) signals poses different but continuing challenges for each activity. Internet signal transmission faces the problems of reliable broadcasting and multicasting of messages, provision of mobility for signal transmitter and for recipient, and limitations on information transfer rate ("speed"). Transmission of digital TV signals faces the problems of providing an interactive system, providing point-to-point information transfer capacity, and mobility of the recipient. The system should be efficient in the sense that the payload or data portion of each transmitted frame is a large fraction of the total frame. At the same time, the system should be able to identify, and compensate for, varying characteristics of the transmission channel, including but not limited to time delay associated with transmission of each frame.

What is needed is a system that provides timing recovery, carrier recovery and estimation of channel characteristics associated with signal propagation in a channel, and that also serves as a guard interval and as a frame synchronizer for the transmitted signal.

Applicant went on to describe the practical application of the claimed invention on page 2, lines 2-16 of Applicant's specification:

The invention meets these needs by providing a pseudo-random or pseudo-noise (PN) sequence for each transmitted frame, where the PN sequence satisfy certain orthogonality and closure relations with respect to algebraic operations such as convolution, Boolean addition and position shift within a segment. A convolution signal is formed between a received signal (transmitted through a channel) and one or more of a selected sequence of the PN sequences. This convolution signal is analyzed to identify the beginning or end of a PN sequence, to identify time delay in the channel, and to permit timing recovery. A carrier frequency for the received signal can be recovered from the signal symbols (bit, nibbles, bytes, etc.) that make up the PN sequences, and synchronization of signal frames can be implemented. Characteristics of the transmission channel can be estimated from the time delays and associated phase shifts. A PN sequence can be positioned within a signal frame to serve as a guard interval for an orthogonal frequency, multiple carrier modulation ("OFDM") scheme. Taken together, these features allow demodulation of a transmitted signal within an OFDM scheme. (Emphasis added.)

Thus, Applicant's specification clearly set forth the problem needed to be solved – timing recovery, carrier recovery and estimation of channel characteristics associated with signal propagation in a channel – and the solution implemented by the claimed invention – providing a pseudo-random sequence for each transmitted frame and forming a convolution signal to identify the time delay in the channel as well as recovering other characteristics of the transmission channel.

Applicant's specification provides further detail explanation of the useful, concrete and tangible result generated by the claimed invention and the practical application of that result:

...From this multipath information, one can identify the beginning and end of each (time delayed) DFT block and the corresponding PN sequence, and thus identify a signal frame within a sequence of signal frames.

After the time delay associated with a received frame is determined or estimated, signal carrier frequency can be recovered and frequency shift and/or frequency drift can be estimated, using the known symbol pattern incorporated in a PN sequence associated with the signal frame.

One or more transmission channel characteristics can be estimated, frame-by-frame or over a group of frames, using a knowledge of time delay and frequency shift and/or frequency drift for the frame(s). (Applicant's specification, page 8, lines 13-23; emphasis added.)

Once the time delay associated with a PN sequence (associated with a signal frame) is determined and compensated for, the PN sequence can be used to synchronize its associated signal frame. (Applicant's specification, page 9, lines 19-21; emphasis added.)

Just as in the cases of *AT&T* and *State Street*, the claimed invention of claim 1 receives information, processes the information and generates a useful, concrete and tangible result in the form of a *time* value which may be temporarily stored and then used or relied upon by other parts of the system for various purposes, including but not limited to timing recovery, carrier recovery, and estimation of channel characteristics. Therefore, the claimed invention of claim 1 *as a whole* provides a useful, concrete and tangible result and accomplishes a practical application. Hence, claim 1 recites statutory subject matter under 35 U.S.C. §101.

In arriving at the §101 rejection of claim 1, the Examiner has omitted the important claim limitation of "determining from the remainder signal at least one time at which said selected sequence $PN(t;k)$ ($k = k1, k1+1, \dots, k2$) associated with said at least one padded signal frame begins in the received signal $Rc(t)$." This claim limitation recites the useful, concrete and tangible result obtained by the claimed method. The Examiner must consider claim 1 as a whole in determining whether the claim meets the statutory subject matter requirement under §101.

In the present submission, claim 1 is amended to recite "determining from the remainder signal at least one time..." The claim amendment is supported by Applicant's specification, p. 8, lines 9-16. This claim amendment is made to clarify the claim by stating that the "time" value is determined from the remainder signal.

Claim 6

Claim 6, as amended, recites:

6. A system estimating timing of at least one of the beginning and the end of a received signal in the presence of time delay in a signal transmission channel in an OFDM system, the system comprising a computer that is programmed:

to provide a set of pseudo-random signal m-sequences $PN(t;k)$ ($k = 1, \dots, K; K \geq 1$) for which a convolution signal formed from any two sequences satisfies $PN(t;i) * PN(t + \Delta t;j) = \delta(\Delta t) * \delta(i,j)$, where i and j are index numbers identifying the two sequences, t is a time variable, $\delta(\Delta t)$ is a modified delta function with infinitesimal width $\Delta t1$ ($\delta(\Delta t) = 0$ for $|\Delta t| > \Delta t1$) and $\delta(i,j) = 0$ unless $i = j$;

to receive at least one padded signal frame $Rc(t)$ transmitted through the signal transmission channel in which the signal being transmitted may be received with an uncontrollable time delay $\Delta t(\text{delay})$, where each padded signal frame comprises a signal frame appended to a selected sequence $PN(t;k)$ from the set of pseudo-random signal m-sequences $PN(t;k)$;

to form a composite signal denoted as $Rc(t; \Delta t; \text{comp})$ and given as:

$$Rc(t; \Delta t; \text{comp}) = \sum_{k=k1}^{k2} PN(t + \Delta t; k) * Rc(t),$$

where Δt is a selected time increment and $k1$ and $k2$ satisfy $1 \leq k1 \leq k2 \leq K$;

to form a remainder signal denoted as $R_c(t;rem)$ where
 $R_c(t;rem) = R_c(t) - R_c(t;\Delta t;comp)$; and
to determine from the remainder signal at least one time at
which said selected sequence $PN(t;k)$ ($k = k_1, k_1+1, \dots, k_2$) associated
with said at least one received padded signal frame begins in the
received signal $R_c(t)$. (Emphasis added.)

For the same reasons stated above with reference to claim 1, claim 6 meets the statutory subject matter requirement under §101 by reciting "to determine from the remainder signal at least one time at which said selected sequence $PN(t;k)$ ($k = k_1, k_1+1, \dots, k_2$) associated with said at least one received padded signal frame begins in the received signal $R_c(t)$." Claim 6, when considered as a whole, provides a "time" value as a useful, concrete and tangible result and the claim invention as a whole accomplishes a practical application. Hence, claim 6 recites statutory subject matter under 35 U.S.C. §101.

In the present submission, claim 6 is amended to recite "to determine from the remainder signal at least one time..." The claim amendment is supported by Applicant's specification, p. 8, lines 9-16. This claim amendment is made to clarify the claim by stating that the "time" value is determined from the remainder signal.

Claims 2-5 and 7-10

Claims 2-5 and 7-10, dependent upon respective independent claims 1 and 6, recite statutory subject matter under 35 U.S.C. §101 for the same reasons as the associated independent claims.

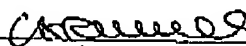
For the above reasons, Applicant submits that claims 1-10 are directed to statutory subject matter. Withdrawal of the §101 rejection is respectfully requested.

CONCLUSION

Claims 1-10 are pending in the present application. Claims 1 and 6 have been amended to overcome the Examiner's claim objections and to clarify the claims. The amendments to the specification made herein deal only with correcting clerical errors and form. No new matter has been entered. Accordingly, the application is in condition for allowance. If the Examiner would like to discuss any aspect of this application, the Examiner is invited to contact the undersigned at (408) 382-0480.

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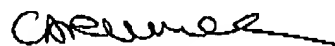


Attorney for Applicant(s)

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Date of Signature

Respectfully submitted,



Carmen C. Cook
Attorney for Applicant(s)
Reg. No. 42,433
Patent Law Group LLP
2635 N. First St.
Suite 223
San Jose, CA 95134
Tel (408) 382-0480 x208
Fax (408) 382-0481